



Can Computers Build Muscles?

Scientific approach to physical training



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In this article, Paul Ward discusses the advancements in bodybuilding technology over the past 20 years, with a particular focus on the computerization of exercise equipment. He highlights the potential of these high-tech machines in providing individualized workouts, diagnosing muscular strengths and weaknesses, and programming optimal exercise routines. The article also introduces Ariel LifeSystems, a company producing advanced computerized exercise equipment. These machines, such as the CES 5000 Multi-Function machine and the CES 5000 Arm-Leg machine, offer a wide range of exercises and can store large volumes of training information for efficient program analysis. The article also discusses the advantages of these machines over traditional free weights and resistance equipment, including the ability to control and adjust exercise parameters, and the potential for unidirectional and bidirectional training exercises.

The article discusses the benefits of using computerized workout machines for bodybuilding training. These machines provide resistance for each exercise while matching the acceleration patterns encountered in natural movements. They also have the ability to add and subtract weight throughout the range of motion and measure the speed of motion. The article further explains different training programs such as work training, fatigue training, timed exercise, combination dynamic-isometric sticking point, spectrum training of intensity, and constant velocity training. These programs aim to control the volume of work, preselect the desired fatigue level, specify the time for the completion of a specific exercise, develop maximal recruitment of all types of muscle fibers, train the muscles at different speeds of movement, and perform isokinetic training with hydraulic resistance equipment. The article concludes by listing the reasons why computerized workout machines are at the cutting edge of bodybuilding training.

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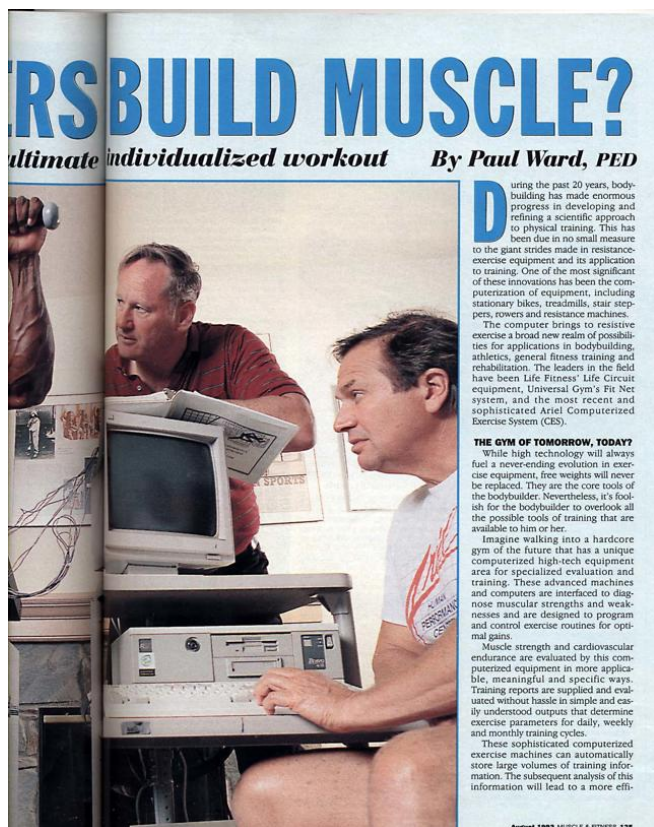
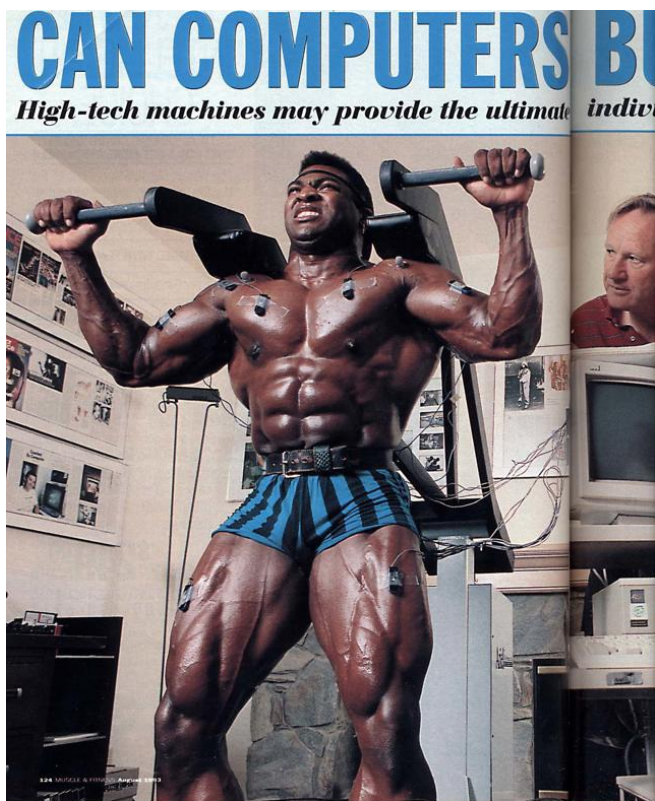
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Below find a reprint of the 12 relevant pages of the article "Can Computers Build Muscles?" in "Muscle and Fitness":



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bodybuilder can concentrate on maximally contracting the muscle at all points in the range of motion. The results are more growth. Again, free weights and conventional machines can't provide this.

Moreover, the machines can be programmed to move at any desired speed, which allows the user to vary the force he or she desires. This enables the bodybuilder to train all muscle fibers from the slow-twitch fibers to the fast-twitch fibers — and every muscle fiber in between — by performing repetitions at different intensities (Figure 1).

3) THE ACCOMMODATING VELOCITY (ACCELERATION) PROGRAM While the accommodating resistance mode matches the strength curve of the specific individual, the accommodating velocity mode matches the specific individual velocity patterns.

Acceleration is involved in all exercise motions. This program provides the appropriate resistance for each exercise while matching the acceleration patterns encountered in natural movements of any prescribed acceleration or velocity pattern. This allows the bodybuilder to train the muscles at velocities and acceleration patterns that have never been available before with free weights and conventional machines.

This mode also simulates the traditional isotonic movements common with free weights. In addition, the computerized machines have the ability to add and subtract weight throughout the range of motion; and 2) measure the speed of motion.

4) WORK TRAINING The main objective of this training program is to develop a program that can be programmed to benefit strength, mass, local muscular endurance and bodyfat reduction, but the best application of this mode is to shape and define muscle.

The work training mode requires the user to complete a predetermined amount of work at a preselected velocity. The controlling factor is the amount of work to be performed. If you use a small amount of force, the number of repetitions needed will be greater and the length of time needed to achieve the amount of force will be longer. On the other hand, if the user decides to work at higher intensities, the number of repetitions will be fewer and the time needed to perform the work will be reduced.

The program is highly motivational and allows you to do more work in less time. It also provides a useful index of performance (the amount of

work divided by the number of repetitions needed to complete the preassigned work). Also, the time needed to perform the workload is another index of performance.

For example, you may assign a workload of 10,000 pounds. The bodybuilder can perform this work by executing 100 repetitions, which would give an index of 100 pounds per repetition. If the bodybuilder performed 10,000 pounds of work in 80 repetitions, then the work index would be 125 pounds per repetition (10,000/80=125 pounds). If you consider the time in which the total work was performed, you would have a power index. This power index and the other evaluations mentioned above can be used as evaluation tools, to develop training goals and/or to provide motivation for the bodybuilder.

5) FATIGUE TRAINING Fatigue training allows the bodybuilder to pre-select the desired fatigue level. This takes the guesswork out of selecting the number of repetitions needed to produce exhaustion.

The fatigue level is determined by the machine when two consecutive repetitions fall below the preselected fatigue level. For example, if a 75% fatigue level is preselected, the exercise will terminate when the user has lost 25% of his or her strength.

Depending upon the specific fatigue level selected, the bodybuilder can use this program to achieve gains in strength, mass, definition, bodyfat reduction, cardiovascular conditioning and/or local muscle endurance.

If a higher fatigue level (80-90%) is selected, then more mass and strength are developed. A preselection of a moderate fatigue level (65-75%) will produce shaping and definition benefits. The selection of a low fatigue level (50% or below) will produce improved local muscle endurance and increase fat burning (see Figure 3).

6) TIMED EXERCISE In this mode a certain amount of time is specified for the completion of a specific exercise or entire workout. At the end of the specified time, the exercise will be terminated regardless of the amount of work or repetitions completed. In all, the timing function can be used to control the time allowed for the completion of a single set, group of sets, the time between sets, and the total time for a total group of exercises.

This function allows for the equal time distribution for each exercise and the control of the total training time. This function can be applied to any

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HI-TECH

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bodybuilding objective.

7) THE COMBINATION DYNAMIC-ISOMETRIC STICKING POINT This program combines a regular dynamic movement with up to eight sticking points. The length of time for each separate sticking point can be set from 1-5 seconds as desired.

This program has two basic objectives. One is to develop maximal recruitment of all types of muscle fibers, which results in maximal increases in strength and hypertrophy. The second objective is to increase the weak points in the range of motion.

The combination of dynamic and isometric exercise has some very good support in scientific literature regarding its effectiveness as a strength and mass builder. Nevertheless, up until the computer-controlled machines, performing this type of training was time-consuming, dull and difficult. CES machines, on the other hand, make this effective brand of exercise much easier to do. There is great potential to develop mass and strength using this program (Figure 4).

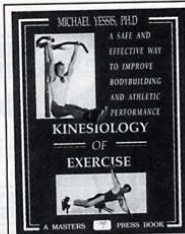
8) SPECTRUM TRAINING OF INTENSITY Spectrum training involves training the muscles at many different speeds of movement. By doing this, the bodybuilder can be sure to train fast-twitch, slow-twitch and intermediate muscle fibers.

The basic aim of this training mode is to maximally develop mass and strength — and this program may be the best mass-training program in existence! Spectrum training can vary speed in successive sets or vary the speed in successive repetitions — or a combination of both.

You can go from slow speed to fast, or vice versa, or choose from many other variations. Here's an example of a slow-to-fast pattern and a fast-to-slow pattern:

SETS	SLOW-TO-FAST PATTERN	FAST-TO-SLOW PATTERN
1	Slow Speed: 1-4 Reps	Fast Speed: 9-12 Reps
2	Medium Speed: 5-8 Reps	Medium Speed: 6-8 Reps
3	Fast Speed: 9-12 Reps	Slow Speed: 1-4 Reps

One method of spectrum training varies the speed of exercise between each succeeding set. The first set is performed at a slow speed while the second set is performed at medium speed. Then the third set is performed at fast speed. Any desired number of



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sets and repetitions can be used with any speed of movement.

Another way of applying spectrum training is to vary the speed of movement for each repetition in a set. For example, the first repetition is performed at slow speed while the second repetition is performed at medium speed. Then the third repetition is performed at a fast speed. Any combination of speeds and number of repetitions, sets or patterns can be programmed.

The latter method of applying spectrum training is really similar to pyramiding with free weights or conventional machine exercises. The pyramid can be an ascending pattern, where the speed of movement on each succeeding repetition is increased until muscular failure. In this case the resistance begins near maximum and on each succeeding repetition it's automatically reduced until the desired level of fatigue is reached (Figure 5).

Another pyramid pattern is the descending form. In this pattern the speed of movement moves progressively slower from a very fast speed to a very slow movement. The resistance at first is very light and progresses to a very heavy resistance. One continues to execute repetitions until muscular failure (Figure 6).

Other versions can be used in combinations, i.e., ascending-descending or descending-ascending (figures 7 and 8) — whatever the bodybuilder desires. These programs can produce the ultimate pump.

9) CONSTANT VELOCITY TRAINING Constant velocity training is isokinetic training performed with isokinetic resistance equipment. This is

also known as accommodating resistance. The velocity of the movement is constant while the force at each point in the range of motion varies with the biomechanics and muscle-tendonous unit length. As you move through the range of motion, the resistance will be different at each point within that range. This type of training benefits strength, shaping and local muscular endurance and helps reduce

sents the speed of movement in degrees per second. The fewer degrees per second, the more the resistance applied during the exercise. The more degrees per second, the less the resistance.

SPECTRUM TRAINING

Below are four different pyramiding forms that can be used in spectrum pyramiding training. Except for the numbers indicating amount of repetitions, each number in the chart represents

Repetition	Ascending	Descending	Ascending/Descending	Descending/Ascending
1	20	150	20	120
2	30	120	40	100
3	40	110	60	80
4	50	100	80	60
5	60	90	100	40
6	70	80	120	20
7	80	70	120	20
8	90	60	100	40
9	100	50	80	60
10	110	40	60	80
11	120	30	40	100
12	130	20	20	120

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bodyfat (Figure 9).

NEW GENERATION COMPUTERIZED EXERCISE SYSTEMS: A QUANTUM LEAP FORWARD

A few reasons why the new computerized workout machines are at the cutting edge of bodybuilding training include:

- 1) The computers accurately monitor and control velocity and resistance throughout the range of motion.
- 2) Variable velocity can be programmed to over 1,000 degrees per second in each direction for acceleration and exercise specificity.
- 3) Variable resistance can be programmed to over 1,000 pounds in each direction.
- 4) Pyramiding of resistance or speed can be programmed in each direction.
- 5) Range of motion can be programmed.
- 6) Velocity or resistance can be independently controlled in each direction of every repetition.
- 7) Computerized diagnostics and testing programs can be used to control range of motion, velocity, strength, peak force, peak hold, delay time and fatigue-injury or training.
- 8) The entire range of motion can

be programmed for dynamic calibration.

9) Each individual's exercise and diagnostic history is stored and is available for immediate recall.

10) Comparison information is visually displayed on the color monitor. Also, the machines can print color graphs, charts, tabloid comparisons and previous exercise data and compare them with current performances and/or optimal performances, training and rehabilitation goals set earlier.

11) The machines display a performance profile that provides instant data, including of average force, power or speed of each repetition lifted; the maximum of each repetition, the average of both up and down movements; and total pounds lifted.

12) They display a performance chart that illustrates the force, velocity, work and power created in relation to the time, the position of the bar and the pace of lifting.

13) They calculate and report caloric expenditures for each exercise and the total for each training session.

14) Over 30 different exercises can be performed on each exercise machine for total body exercise.

15) A setup for testing and/or training can be accomplished in a matter of

seconds.

16) An endurance program can automatically reduce resistance with each repetition to accommodate the user's level of fatigue.

17) Comparison information can be displayed on the screen and printed with color graphics in a tabloid format. Some of the comparisons include:

- Present performance/previous performance.
- Pre-injury performance/postinjury performance.
- Actual performance/ideal performance.
- Right limb/left limb.
- Extensors/flexors.
- Force/power/speed — any comparison combination.
- 18) Up to nine different exercise result formats may be selectively displayed on the monitor and copied by the printer.
- 19) In addition to the exercise results, the following data can be displayed:
 - Endurance by repetition.
 - Endurance by time.
 - Strength curve analysis.
 - Fatigue curves.
- 20) Performance goals can be displayed during an exercise for each movement. A target value can be high-

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